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ABSTRACT

A study compared text-connecting inferencing and text integration skills of hearing-impaired (HI) students who had surpassed the documented fourth-grade plateau in reading comprehension with those who had not. These groups were also compared to skilled and less-skilled normal-hearing (NH) fourth graders. Subjects read a four-page narrative and answered inference and premise questions. Results indicated that HI readers had greater difficulty making inferences than NH readers, but inferencing ability did not explain the differences between skilled and less-skilled HI readers. NH readers and skilled HI readers integrated premises separated in the text as easily as premises located adjacently. However, less-skilled NH readers were severely affected by premise distance, even when both premises were recalled. Thus, poor text integration may explain why some HI readers plateau in their reading achievement. The results have implications for comprehension monitoring and current instructional practices. (Author/MSE)

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Inferential Comprehension in Skilled and Less-Skilled, Hearing-Impaired Readers

Elizabeth M. Wilkes

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Abstract

This study compared the text-connecting inferencing and text integration skills of hearing-impaired (HI) students who had surpassed the documented fourth-grade plateau in reading comprehension with those who had not. These groups were also compared to skilled and less-skilled, normal-hearing (NH) fourth graders. Subjects read a four-page narrative and then answered inference and premise questions. The results indicated that HI readers had greater difficulty making inferences than NH readers, but inferencing ability did not explain the differences between skilled and less-skilled HI readers. NH readers and skilled HI readers integrated premises separated in the text as easily as premises located adjacently. However, less-skilled HI readers were severely affected by premise distance, even when both premises were recalled. Thus, poor text integration may explain why some HI readers plateau in their reading achievement. The results are discussed in relation to comprehension monitoring and current instructional practices.

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Hearing-impaired (HI) children face special problems when learning to read. Unlike normal-hearing (NH) children, they most often do not have adequate language skills on which to rely to make sense out of printed materials. It is not surprising then that HI students typically fail to achieve adequate reading levels. In fact, numerous surveys (e.g., DiFrancesca, 1972; Wrightstone, Aranow & Moskowitz, 1963) have shown that HI children are severely delayed in their reading development. Of even greater concern, however, is that these students typically make only marginal reading gains, on the order of one month per academic year, despite additional schooling. As a result, HI students generally do not progress much beyond the third- or fourth-grade level (Balow, Fulton & Peploe, 1971; Furth, 1966a, 1973; Trybus & Karchmer, 1977).

One way to examine the reading problems of the hearing impaired is to try to determine why they tend to plateau around the fourth-grade level on achievement tests. To understand this question better, it is useful to consider the characteristics of these tests. Prior to the fourth grade, evaluation is focused on the reader's decoding skills and vocabulary, but beyond the third grade, emphasis is placed primarily on comprehension and the making of inferences in order to answer test questions (Durrell, 1955; Wilson, 1979). It seems reasonable to assume, based on their achievement scores, that HI children do learn basic decoding skills. In addition, it has been found that word meaning continues to develop in HI adults, although paragraph comprehension does not (Hammermeister, 1971). Thus it would appear that the documented reading failure is more likely due to higher level comprehension deficits.

Poor inference generation during reading may be one area of text comprehension which accounts for the reading difficulties of the hearing impaired. The comprehension of texts, whether oral or written, is a complex process which involves much more than determining the meaning of individual sentences. Fisher

and Smith (1977) note that the listener or reader must be able to integrate information across sentences in order to fully derive the intended message. Further, the reader/listener must relate the text to personal knowledge in order to achieve understanding. The reader/listener must apply logic to finding relationships among stated concepts. Finally, the reader/listener must actively process the text, not only applying knowledge and logic but knowing when and how much to use them. All of these aspects of text processing contribute in important ways to the process of comprehension, and all are aspects of inferencing. Thus, inferencing is a crucial part of comprehension (Carroll, 1972; Flood, 1981; Frederickson, 1979; Trabasso & Nicholas, 1980).

The results of recent investigations concerning inferencing in HI readers have been equivocal. Wilson (1979) performed one of the first explicit studies of inferencing ability in HI children. The study, using a false-recognition paradigm, looked for developmental improvement, compared performance on literal items and inference items, and varied whether the task was administered via signing or reading. Hearing-impaired readers were also administered a separate test to assess comprehension of the six syntactic constructions used in the experiment. For NH readers, no improvement was found from second to fifth grade in the recognition of true or false inferences, or true or false explicit items. There was either a strong ceiling effect with even the youngest NH readers performing quite accurately, or the paradigm was not sensitive to improvement. For the HI readers, there was an improvement as a function of reading level on the recognition of false inferences and on explicit recall, but no improvement in the ability to recognize true inferences. In fact, the HI students reading at the fifth grade level were significantly worse at recognizing a true inference than the NH second-grade readers, despite being an average of eight years older. Memory for explicit information was similar between the two groups of readers, and recognition of false inferences was only

slightly lower for HI readers. Wilson also found that inferencing was independent of syntactic structure; deaf readers often failed to make the inference even if they understood the construction.

Wilson's study indicates that inferencing may be a problem for HI readers, above and beyond comprehension of the sentence structures. Further, HI subjects were capable of processing propositional information as well as NH subjects reading at the same grade level, which suggests that memory and decoding skills are adequate for reading.

Pinhas (1984) compared NH readers and two groups of HI subjects, of which one read the experimental text and the other viewed a signed presentation. All subjects were reading at approximately the same level (means across groups of 4.6 to 5.0). Students read five short narratives accompanied by yes/no questions which assessed literal information and two types of inferences. Results revealed that the NH group and the sign presentation group were as accurate with inference questions as with literal questions. However, reaction time data indicated that many subjects were trading speed for accuracy in their response to inferential questions. Hearing-impaired subjects in the written presentation group found inference questions to be harder than literal questions. Thus, HI students may approach written texts differently from through-the-air texts.

Pinhas found no difference in accuracy among the groups. However, a covariate of age was used in the data analysis because Pinhas felt that older, HI subjects, might be faster or more accurate due to greater world experience. An inspection of unadjusted means revealed, to the contrary, that when age was removed as a covariate, the younger, NH subjects had higher accuracy scores, not lower.

Sarachan-Deily (1985) matched NH and HI high school students on the basis of age, rather than reading ability. Hearing-impaired students had a mean reading

grade equivalent of 5.4, while NH students had a mean of 10.5. Subjects read one five-paragraph narrative and then produced written recalls. Recalls were analyzed in terms of the number of explicit propositions (verbatim and paraphrase) and number of inferences included. Incorrect recalls or inferences were not counted in this analysis. It was found that NH subjects produced longer recalls, attributable to the inclusion of more explicit information. The groups did not differ in the number of inferences included in their recalls. However, when the quality of the inferences was considered, it as found that HI readers were as likely to include false inferences as true inferences in their recalls, while NH readers included very few false inferences.

Another analysis compared HI readers classified as poor, average or good readers. Of the twenty HI subjects, 4 had reading scores of less than grade four (poor), nine were reading between grades 4 and 5 (average), and seven were reading at the sixth-grade level or above (good). No main effect difference between the reading levels was found in recalls but there was a significant interaction due to the fact that good HI readers recalled more true propositions than average or poor readers. All reading levels had similar means for false propositions, and true and false inferences. The within-reading level analysis revealed that all three reading levels were as likely to include false inferences in their recalls as true inferences. Higher reading levels produced better recall of explicit content, mirroring the NH readers, but accuracy of inference generation did not improve.

In general, the results of these studies indicate that inferencing for HI readers is more difficult than for NH readers. Further, neither Sarachan-Deily (1985) nor Wilson (1979) found any improvement in inferencing as a function of reading level for HI readers. However, these studies did not directly compare, with adequate group sizes, HI readers who were high-achieving with those who were low-achieving. In addition, the experimental paradigms may have affected the

results. Wilson used artificial three-sentence texts that may have been problematic for HI readers because of the limited context such texts provide. On the other hand, Sarachan-Deily used a naturalistic text but assessed inferencing through recall, which has been found to not be a sensitive measure of inferencing, due to the fact that poor readers rarely volunteer inferred material (e.g., Bridge & Tierney, 1981).

The Hypothesis

The purpose of this study was to examine in more detail the inferential comprehension of skilled and less-skilled HI readers in order to clarify the results of earlier research and to determine if inferencing ability is a factor in the levelling off of achievement in HI readers. No inference study to date has compared HI readers who are reading above the fourth-grade level, the general point of the plateau, with those who have not. Given the nature of achievement tests, as described above, inferential comprehension seems a likely starting point for determining the cause of this plateau. Furthermore, teachers of the hearing-impaired frequently report that students have problems in such inferencing activities as determining the referent of pronouns (also documented by Quigley et al., 1976) and the recognizing of causal connections between statements.

The specific hypothesis was that HI readers plateau in their development because they do not learn to derive information that is not explicitly stated in the text, that is, learn to make reliable inferences. Such a hypothesis may seem to suggest that the hearing impaired have a cognitive deficit, since inferencing is as much a cognitive skill as a reading or language skill. However, nonverbal measures of intelligence indicate that the hearing impaired are as cognitively capable as the general population (Furth, 1966b, 1971; Furth & Youniss, 1971). Rather, the suggestion, supported by Pinhas' (1984) findings, is that there may be a deficit in inferential comprehension specific to written texts.

Since differences in inferencing while reading were expected between skilled and less-skilled readers, the study was also designed to determine the probable cause of those differences. It was hypothesized that an area directly related to inferencing would be involved, rather than factors such as memory, linguistic ability, attention or motivation. The area that was examined involved the ability to combine explicit information in the text in order to generate an inference. The premises for a text-connecting inference are not necessarily located together in a text. Theoretically, the integration of premise information should be more difficult across larger distances than integration of adjacent premises because, in order for the inference to be made, the first premise must still be available in memory when the second premise is encountered later in the text. If poor text integration caused lower inferencing performance for less-skilled readers, they would be more affected by the distance between the premise statements.

The reason that text integration was targeted as a possible cause of inferencing difficulty is that earlier research with hearing children has shown it to be a factor in developmental improvement in inferencing. For young NH children, the separation of the information necessary for the inference reduces the likelihood that the inference will be made (Johnson & Smith, 1981). However, by fifth grade, this effect disappears for both skilled and less-skilled readers. Of concern here was whether older HI readers at similar reading levels as younger hearing readers would demonstrate the same effect.

In summary, the following questions were asked about the reading of HI students: (1) Do HI readers who have failed to achieve reading competence beyond the fourth-grade level have poorer text-based inferencing skills than more successful HI readers? (2) Do HI readers show an effect for premise distance? and (3) How do the results for HI readers compare to those found for younger hearing readers?

METHOD

The experimental task required subjects to read a four-page passage and then answer questions requiring inferences about information not stated directly in the text (implicit condition). In order to determine whether there were inferencing differences between skilled and less-skilled readers, it was also necessary to include an experimental condition in which the inferences did not have to be made but were stated in the text (explicit condition). In the explicit condition, factors such as language ability, attention and motivation would have the same effect as in the implicit condition, thus providing a baseline for comparison. By comparing performance between these two conditions, it could be determined how much of the results was due to the need to make inferences in the implicit condition and how much was due to other factors. In other words, an interaction between reading level and explicitness was needed to show inferencing differences. If the performance gap between the two conditions was the same for skilled and less-skilled readers, then it would more likely be the case that apparent inferencing differences are really due to other factors.

In order to ascertain if text integration was a possible cause of inferencing differences, it was important to control for differences in memory. Less-skilled readers might perform poorly when premises were separated because they could not hold the premises in memory long enough to make the inference. Therefore, it was necessary to assess recall of premise information and to examine only those inference questions for which both premises were recalled. If text integration were a factor and not memory, less-skilled readers would be affected by the distance between premises, even if they remember both premises.

Subjects. Forty-four hearing-impaired (HI) and 48 normal-hearing (NH) students served as subjects. All subjects were average or above in intellectual

functioning, based on IQ tests or school report, and had no known uncorrected vision problems or additional handicaps (other than hearing impairment). Twenty-four skilled and 24 less-skilled NH readers were selected from the fourth grade of 14 schools in a public school system based on their scores on the vocabulary and reading comprehension subtests of the Iowa Test of Basic Skills (1982). All NH subjects had reading vocabulary scores which were at or above grade level. NH readers were divided into two groups based on whether each subject's comprehension grade equivalency was above or below 4.5, with those whose scores clustered around 4.5 being eliminated. Skilled NH readers had a mean comprehension score of 6.1 and less-skilled NH readers a mean of 3.6.

Hearing-impaired subjects were selected from the populations of five New England programs for the hearing-impaired, and included both signing and oral subjects. No effort was made to balance between preferred mode of communication since it was not of primary interest in this research. All HI subjects had an average hearing loss of at least 68 dB in the speech frequencies in the better ear and had acquired their losses prelingually. Subjects were paired on the basis of hearing loss and age. Skilled HI readers had a mean age of 16-3 years and less-skilled HI readers had a mean age of 16-2 years. Mean hearing loss as measured by better ear average (BEA) in the speech frequencies for skilled HI readers was 95 dB, and for less-skilled was 97 dB.

Reading achievement data were often not available for HI subjects. Programs for the hearing impaired have reacted to the growing body of research which indicates questionable validity of formalized testing with HI readers (Beggs & Breslaw, 1983; LaSasso, 1985; LaSasso & Davey, 1983; Webster, Wood & Griffiths, 1981; Wood, Griffiths & Webster, 1981). In addition, publishers of the most frequently administered achievement test, the Stanford Achievement Test-Hearing Impaired (SAT-HI) have recently recommended not administering the vocabulary

subtest from the battery because of reliability problems (Administering the 1982 Stanford, 1983).

Because of these problems, reading level was determined from several sources. SAT-HI, when available, individualized educational plans (IEP's), and teacher reports of current placement. If there were discrepancies, such as high SAT-HI scores in comparison to IEP data, teacher report was considered to be the most valid indication. Reading comprehension scores were available and considered valid for 23 of the HI subjects. No attempt was made to match HI subjects on reading vocabulary or general language ability. Any initial differences in these areas between the skilled and less-skilled subjects would be controlled by using the explicit condition as a baseline. Each pair of HI readers was selected so that the reading comprehension grade level for the less-skilled member was between 3.0 and 4.5 (mean = 3.5) and so that the gap between the lower and higher member was at least two grade levels. Summary data for all subjects are presented in Table 1.

Insert Table 1

The students were administered a word recognition list, based on words in the experimental text and Harris & Jacobson's (1982) graded word lists. Any word in the text which received a rating of fourth grade or higher was included on the word list. A word recognition score of eighty-nine percent or better (25 of 28 words correct) was necessary for inclusion in the experiment. The word recognition measure provided some guarantee that poorer readers could at least decode the experimental text. Both skilled and less-skilled readers were administered the word recognition list so that both groups would be equally primed for the story.

Materials. A children's story of approximately 200 sentences, entitled *Joseph, The Border Guard,* served as the stimulus material. It was extensively revised from Johnson and Smith (1981) and was rewritten at approximately a seond-grade level. Sixteen sets of premises, affording a variety of inferences, were embedded within the text. Four versions of the story were prepared. In two versions, used for the text-explicit condition, the premises were embedded but followed by an explicit statement of the inference. In the other two story versions, used for the text-implicit condition, the inference statement was omitted and left to the reader to deduce. The only difference between the text-explicit and the text-implicit condition was the necessity of making inferences in the latter, in order to answer post-reading questions.

Within each of the two story conditions (explicit and implicit), the premises were distributed in two ways. For half of the premise sets, the two premises needed to make the inference were adjacent to each other or separated by only a sentence. For the remaining sets, the premises were separated by a varying number of sentences: mean = 27 sentences, range = 6 - 107. In the story-explicit condition, the inference statement was presented immediately following the second premise statement.

The two premise types, adjacent or separated, were counterbalanced across the text versions, to control for the possibility that some inferences were harder than others when the premise information was separated and for the possibility that some premise sets were more salient than others (Goetz, 1977). Paired versions (one explicit and one implicit) contained the same sets of adjacent and separated premises.

Inferencing was assessed with 16 identical, multiple-choice questions. The correct choice for each inference question was given as a repetition of the added statement in the explicit version. The foils were taken, as much as possible, from

other vocabulary in the story so that students were not eliminating possible answers solely on the basis of not having seen a word in the story. The inference questions were checked to verify that knowledge of the story was necessary to answer them. Following the inference questions, subjects answered multiple-choice questions which assessed their recall of the premises themselves. This allowed for the determination of whether the reader could recall the premise information, even if the response to the inference question was incorrect. Examples of the questions and text are provided in Figure 1.

Insert Figure 1

Procedure. Students were tested in groups of 2 to 12. They were told, orally or with signing as well, that they would read a story and then would answer questions about it. The task was very familiar to all the subjects. Subjects were asked to tell the experimenter when they had finished reading the story. The text was then removed and each student was given the multiple-choice inference questions. When the inference questions were finished, they were removed and the premise questions were given out. Inference questions were presented first in order to avoid cuing readers to the relevant information, which was assessed by the premise questions. Each experimental session lasted 20 to 40 minutes, with each subject being allowed to take as much time as needed.

RESULTS

This study examined the inferential comprehension of skilled and less-skilled HI readers in order to determine if inferencing differences might be one of the reasons why many HI students fail to make adequate gains in their reading achievement. Secondary questions included whether HI readers are affected by

premise separation, and how the results compare to those for NH students. The means for the various dependent measures are displayed in Table 2.

Insert Table 2

Inference Questions

In order to rule out memory for premise information as a factor in accuracy on inference questions, conditional inference scores were calculated based on only those inference questions for which the subject answered both of the premise questions correctly. For example, if the reader recalled the premises for fourteen of sixteen inference questions, the associated inference score was the percentage correct of those fourteen questions. Such scores were calculated for the explicit condition as well, in order to obtain a baseline for comparison. Explicit scores reflected differences between readers due to language ability, memory or any other factor, except inferencing, which may affect the performance of less-skilled readers. The mean conditional inference score for skilled readers was 74.45, and for less-skilled readers, 41.85. The respective scores in the explicit condition were 91.88 and 67.4. An ANOVA for a reading level (2) by explicitness (2) design indicated main effects for reading level (F [1,40] = 35.98), p = .0001; and explicitness (F [1,40] = 20.41), p = .0001, but no interaction (F [1,40] = 0.73). The lack of interaction suggests that less-skilled readers were no more affected by the need to make inferences than skilled readers. Thus the hypothesis that less-skilled HI readers may plateau in their reading achievement because of a failure to make inferences was not supported, within the limitations of the study.

The Effect of Premise Distance

The second research question concerned whether premise separation influences HI readers' inferencing. This question was posed based on the assumption that real inferencing differences would be found between skilled and less-skilled readers, and was an attempt to determine if text integration was a source of those differences. Again, the analysis required the use of conditional scores, involving only those inferences for which associated premise material was recalled, in order to control for the possibility that separated premises might be more difficult to remember. Because text integration was not involved in answering the questions in the explicit condition, only the implicit condition was considered

Skilled readers' mean scores for the percentage of correct inferences were 76.24 for inferences with adjacent premises and 75.25 for those with separated premises. Less-skilled readers' mean scores were 51.97 for adjacent and 18.79 for separated. A repeated measures ANOVA for a 2 (reading level) by 2 (premise distance) design revealed significant main effects for reading level (F [1,20] = 30.47, p = .0001), and premise distance (F [1,20] = 6.06, p = .02), and a significant interaction (F [1,20] = 5.37, p = .03). Figure 2 displays the interaction.

Insert Figure 2

Skilled readers were unaffected by the distance between the premises, but less-skilled readers were severely affected, with their scores on separated-premise inference questions being lower than chance. Thus, although the initial analysis showed little difference in inferencing ability, less-skilled readers were largely unable to integrate information that is not located together in the text. This effect is particulary noteworthy because of the use of conditional scores. Even when less-skilled readers remembered both separated premises, they found it extremely difficult to integrate these premises into an inference.

Comparison of HI and NH Readers

The first comparison of NH and HI subjects together was for accuracy on inference questions, using conditional scores, as described above. The means for HI readers were reported above, for skilled NH readers the means were 91.1% and 86.6% for the explicit and implicit conditions, respectively, and the corresponding means for less-skilled NH readers were 88.6% and 67.4%. An ANOVA for a reading level (2) by explicitness (2) by hearing status (2) design revealed that all main effects were significant. In addition, there was a reading level by hearing status interaction (F [1,64] = 12.18, p = .0008), due to the lower scores of less-skilled, HI subjects. The hearing status by explicitness interaction was nearly significant (F [1,64] = 3.73, p = .057). This result provides some indication that given equal recall of premises, HI readers found inferencing a more difficult task than NH readers. The means are displayed in Figure 3.

Insert Figure 3

The final comparison involved differences in performance by NH and HI subjects as a result of premise distance. As with the above analysis, the reading level by hearing status interaction was significant (F [1,42] = 12.61, p = .001), attributable again to the much lower performance of the less-skilled, HI readers. The premise distance by hearing status interaction was not significant. This was apparently due to skilled HI readers having less change in accuracy from adjacent to separated premises than the NH readers, while less-skilled HI readers had a greater change in accuracy, with the net result of balancing out the differences. However, the three-way interaction (including reading level) was not significant either (F[1, 42] = 2.93, p = .10), due to wide variability within individual cells.

DISCUSSION

This study compared skilled and less-skilled hearing-impaired (HI) and normal-hearing (NH) readers on the ability to answer text-based inference questions after reading a lengthy narrative passage. Of concern was whether poor inferencing could account for why some HI readers fail to progress in their reading achievement beyond the fourth-grade level. It was also important to compare the performance of HI readers to NH readers of similar reading ability in order to determine if inference generation was more troublesome, in general, for HI readers.

The results of the study indicate that, in general, the ability to generate inferences did not account for differences in reading ability between skilled and less-skilled HI readers. Although less-skilled readers were less accurate overall, both skilled and less-skilled readers found inference questions more difficult than the same questions assessing explicit content and this effect was of similar magnitude for both groups.

The second research question asked if HI readers were affected by premise distance. Skilled HI readers answered premise-separated inference questions as accurately as premise-adjacent inference questions. However, less-skilled readers were profoundly affected by premise separation. Thus, a significant amount of less-skilled HI readers' overall lower performance may be accounted for by the inability to integrate material that is not located together in the text. Since premise placement was counterbalanced across versions of the text, poor language skills could not account for this effect because linguistic difficulty was identical for premise-adjacent and premise-separated inferences.

The most obvious result of the comparisons that were made between NH and HI readers is that the NH subjects consistently outperformed HI subjects. However,

the differences were largely attributable to the much lower performance of less-skilled HI readers. Post hoc comparisons of means generally indicated that skilled HI readers were similar to less-skilled NH readers in ability to answer inference questions and in reaction to the distance between the premises. It would appear that despite apparently similar reading levels, the linguistic deficits of the skilled HI students were severe enough to depress their scores in relation to the NH skilled readers.

Less-skilled HI readers may have been reading at slightly lower levels than less-skilled NH readers due to the difference in how reading scores were obtained. Grade equivalents for NH subjects were based on achievement test data and thus represent independent reading levels, while grade equivalents for half of the HI subjects may have represented instructional reading levels, with probably lower corresponding independent reading levels. This difference in subject selection, when combined with low linguistic ability, may account for a portion of the very low accuracy level of less-skilled HI subjects in comparison to less-skilled NH subjects.

One of the more interesting comparisons of HI and NH students involved a hearing status by explicitness interaction that was marginally significant. While some caution must be observed in the interpretation of this result, the indication is that HI subjects, regardless of reading ability, had a greater change in performance from the explicit condition to the condition requiring inferencing than NH subjects, even when memory was controlled for through the use of conditional scores. HI readers, in the explicit condition, were much closer in accuracy to NH readers. The interaction cannot be accounted for solely by subject selection and linguistic differences, which should affect both conditions equally. It seems reasonable to conclude that the impact of the need to make inferences was indeed greater for HI readers, which concurs with Wilson's (1979) findings.

Limitations

The conclusions based on the results of this study are limited to the reading of narrative texts. The use of expository texts may lead to different results. Only one investigation, by Bridge and Tierney (1981), has directly compared text type. Good and poor readers were found to differ in the number of inferences included in their recall of an expository text but not in recall of a narrative. However, weaker background knowledge may have contributed to the lower inferencing level of poor readers. In order to ascertain whether less-skilled readers do indeed experience inferencing problems with expository texts but not with narratives, as the work of Bridge and Tierney suggests, it would be necessary to avoid the confound of unequal background knowledge, perhaps by using a design similar to the one of this study.

Conclusions must also be considered appropriate only for text-connecting inferences, as slot-filling and text-connecting inferences seem to involve different cognitive processes. Slot-filling inferences require the reader to make a connection between the information in the text and personal world knowledge, or long-term memory. Text-based inferences require the reader to make a connection between two or more pieces of information in the text (although world knowledge may be necessary to making that connection). Thus, the first piece of information must still be available in memory when the second piece of information is encountered.

Few studies have directly compared slot-filling and text-connecting inferences in an examination of skilled and less-skilled readers. Malicky and Schienbein (1981), using a narrative passage, found no differences between good and poor readers for either slot-filling or text-connecting inferences. However, developmental studies have found performance affected differentially by inference type (Hildyard, 1976, Omanson, Warren, & Trabasso, 1978). It is possible that neither slot-filling nor text-connecting inferences yield different results for narratives, as was the case with Malicky and Schienbein's study, but one or both types of

inferences could produce differences with expository texts. A comparison of text type and inference type, and their possible interaction, remains an area for future research.

Conclusions and Implications

The results of this study indicate that the less-skilled HI readers exhibited a severe problem integrating information that was not located together in the text, even when both premises were remembered. In addition to affecting performance on text-connecting inferences, poor text integration would also make problematic activities such as determining the main idea of a passage, finding support for an argument from several points in the text, drawing conclusions, or detecting logical inconsistencies in a text. Hence, poor text integration could severely affect performance on higher levels of achievement tests.

If text integration is the source of the problem for less-skilled HI readers, what missing cognitive or reading skills might lead to this deficit? A growing body of literature with hearing students suggests that comprehension monitoring may be involved. One aspect of comprehension monitoring, the detecting of logical inconsistencies in a text, has been found to relate to text integration. The results of several studies indicate that there is a progression in difficulty of identification from lexical, to intrasentential, to intersentential incoherencies (e.g., Pace, 1980). However, poorer readers generally fail altogether at finding inconsistencies that require the integration of information across sentences (Garner, 1980, 1981; Garner & Kraus, 1982).

Several investigators (Canney & Winograd, 1979; Garner, 1981; Markman, 1977, 1979) have suggested that not engaging in text integration leads to a failure to form relations among ideas. Thus, the reader cannot evaluate coherence, or judge his or her comprehension, if the relations are not established. It seems equally

likely that the dependency goes in the other direction: a failure to monitor one's own understanding leads to not actively engaging the text and searching for relations among sentences. Certainly, regardless of direction, these two factors both contribute to inference generation (Schmidt, Schmidt and Tomalis, 1964). Johnson and Smith (1981) likewise hypothesized that inadequate comprehension monitoring may lead to poor text integration. They suggested that, with the third and fifth graders in their study, the effect of premise distance for the younger readers was due to a failure to "strategically retrieve previous information in order to make greater sense of current input" (p. 1221). In other words, the younger readers did not actively process the text, and combined separated premises only when the second happened to trigger recall of the first. The less-skilled, HI readers in the current study functioned much like these younger, NH readers.

Next to nothing is known about the comprehension monitoring of HI readers. In average or above-average NH readers, comprehension monitoring appears to develop somewhat spontaneously, while poorer readers frequently fail to learn to monitor their own understanding (August, Flavell, & Clift, 1984, see Wagoner, 1983, for a literature review). The differences are obvious even in the first grade. Clay (1973) found that skilled first-graders, evidently determining that what they had read aloud did not make sense, spontaneously corrected 53% of their oral reading miscues, while poor readers corrected only 5%. Perhaps, initially, less-skilled readers are too embroiled in the decoding aspects of reading to recognize that the object of reading is not to figure out all the words but to arrive at some meaning. This misconception of reading is then perpetuated, probably by the reading instruction poor readers receive, which tends to focus on improving word identification skills (Allington, 1980; Cazden, 1985; Eder, 1980). Canney and Winograd (1979), in interviews of readers in grades 2, 4, 6 and 8 about the nature of reading, found

that while skilled readers focused on meaning, poor readers, even in the eighth grade, tended to emphasize that reading was getting the words right.

It would be interesting to see what less-skilled HI readers think reading is, but one suspects that their responses would be similar to those of less-skilled, NH readers. In a comparative study of the reading lessons of HI and NH primary school children, Howarth, et al. (1981) found that teachers of HI children stopped their students more frequently and spent significantly more time teaching word meaning. Hearing-impaired children spent a far longer time on reading the text than their matched controls on the same text, however, much of this time was not in reading but in interaction with the teacher.

Baran and Van Houten (1985) found differences in the reading lessons of skilled and less-skilled HI readers. Within a lesson for which the goal was determining the main idea, teachers of less-skilled readers introduced more topic shifts and more explanations, spent more time teaching vocabulary and word recognition skills, and did not introduce the goal until the end of the lesson. These same teachers expected skilled readers to handle the text on their own and introduced the goal of the lesson initially. Baran and Van Houten note that the differences in lessons for the two groups may be due to both teacher perceptions, which direct the lesson, and student responses, based on their ability or lack of ability. However, the evidence leans toward instructional strategies rather than student ability.

> when the integrity of the text was maintained without numerous explications to teach new vocabulary, it was possible for even a low-ranked group to accomplish the lesson goal. Clearly then, the goal of the lesson was within the grasp of the low-ranked students. That two low-ranked groups did not accomplish this goal, at least in this study, may be due to the method of instruction rather than being due to factors internal to the student....
>
> ...Well-intentioned teacher modifications of lessons may indeed serve to perpetuate the weaknesses which have characterized low-ranked students as such. (Baran & Van Houton, 1985, unpaged)

Little sustained reading, and frequent interruptions and vocabulary checks, which these two studies indicate may be typical of less-skilled, HI readers' lessons, are bound to induce a word-oriented conception of reading and heavy reliance on the teacher's external monitoring of comprehension. This perception of what reading is, combined with teacher control of the reading, would likely limit comprehension monitoring to determining if the word was known, with little attention to text integration. Further, text integration would be difficult, if attempted, because earlier-read material could be forgotten during the ensuing class discussion.

One of the keys to remediating text integration and comprehension monitoring deficits in less-skilled HI readers may be simply to alter the method of instruction by spending more time on global comprehension, perhaps through a focus on inferencing. Hansen (1981) notes that merely more exposure to inference questions may provide sufficient practice to improve inference generation, because teachers tend to ask a preponderance of literal comprehension questions (Guszak, 1972). Inference questions stimulate integration of both sentences within the text, and between the text and schematic sources of information. In addition, several experimentally tested instructional methods have been found to improve NH poor readers' inferential comprehension (Carr, Dewitz & Patberg, 1983, Holmes, 1983, Hansen & Pearson, 1983).

Instructional methods designed specifically to enhance comprehension monitoring have also been found to improve the performance of NH less-skilled readers (Babbs, 1984, Carr et al., 1983; Davey & Porter, 1982; Grabe & Mann, 1984; Short & Ryan, 1984). These methods all emphasize the reader's active involvement in determining whether he or she has understood, and the internalization of strategies for identifying the cause of misunderstanding and resolving the breakdown.

In summary, less-skilled, hearing-impaired readers may plateau in their achievement because of poor text integration abilities. It has been suggested that poor text integration may be due to inadequate comprehension monitoring, perhaps because typical reading instruction actually impedes individual-reader control of comprehension, and instead, may lead to a mistaken notion that the purpose of reading is to figure out the words. However, there are several instructional approaches, tested with hearing readers, that appear to be effective in counteracting this misconception of reading or the results of it. It is likely that these procedures would be just as effective with hearing-impaired readers

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Table 1. Age, Reading Level, and Hearing Loss (Range) for Normal-Hearing (NH) and Hearing-Impaired (HI) Readers.

	Age in Years	Comprehension Grade Level	Hearing Loss (dB) BEA
NH			
Skilled	9-8 (9-1 to 10-11)	6.1 (5.0 - 7.6)	----- -----
Less-skilled	9-6 (8-7 to 10-6)	3.8 (3.0 - 4.3)	----- -----
HI			
Skilled	16-3 (11-6 to 18-9)	6.9 (5.0 - 11.0)	95 (73 - 117)
Less-Skilled	16-2 (11-8 to 20-10)	3.5 (3.0 - 4.5)	97 (68 - 129)

Table 2. Total, Adjacent, and Separated inference means (and standard deviations) when both premises were remembered for Normal-Hearing (NH) and Hearing-Impaired (HI) readers by reading ability and explicitness condition.

	Skilled		Less-skilled	
	Explicit	Implicit	Explicit	Implicit
NH				
Inferences	91.1 (6.3)	86.6 (12.6)	88.6 (11.2)	72.6 (16.1)
Adjacent	------	91.7 (18.5)	------	80.0 (17.7)
Separated	------	82.4 (11.4)	------	72.8 (28.4)
HI				
Inferences	91.9 (7.3)	74.4 (17.4)	67.4 (17.4)	41.8 (18.4)
Adjacent	------	76.2 (17.4)	------	52.0 (31.3)
Separated	------	75.2 (21.4)	------	18.8 (22.2)

Figure 1. Examples of adjacent and separated premise information and the premise and inference questions that were used.

Example 1.

	Premise Information	
	Adjacent	Separated
Implicit	You needed a ticket to go into the kingdom. The kingdom was so little that you could visit it only once a year.	You needed a ticket to go into the kingdom....(11 intervening sentences on a different topic)... The kingdom was so little that you could visit it only once a year.
Explicit Added Sentence	You got one ticket each year.	
Inference/ Explicit Question	How many tickets could you get each year?	
Premise Questions	What did you need to get into the kingdom? How often could you visit the kingdom?	

Example 2.

	Premise Information	
	Adjacent	Separated
Implicit	Joseph tried to play the fiddle. But he made only awful sounds. Then he remembered the flute for brown rats. Only brown rats could play it.	It's a flute for brown rats. Only brown rats can play it... (70 intervening sentences)...Joseph tried to play the fiddle. But he made only awful sounds. Then he remembered the trouble with the rat's flute.
Explicit Added Sentence	This must be a fiddle that only cats can play.	
Inference/ Explicit Question	Why couldn't Joseph play the cat's fiddle?	
Premise Questions	What happened when Joseph played the fiddle? What did Joseph remember when he played the fiddle?	

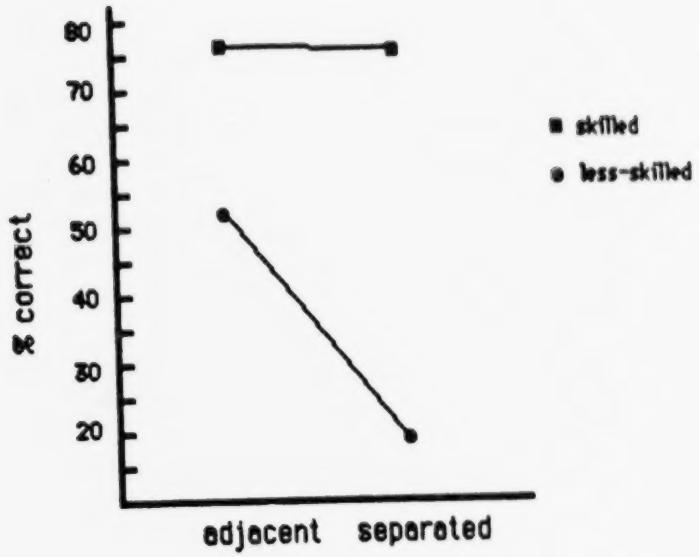

Figure 2. Reading level by premise distance interaction for hearing-impaired subjects.

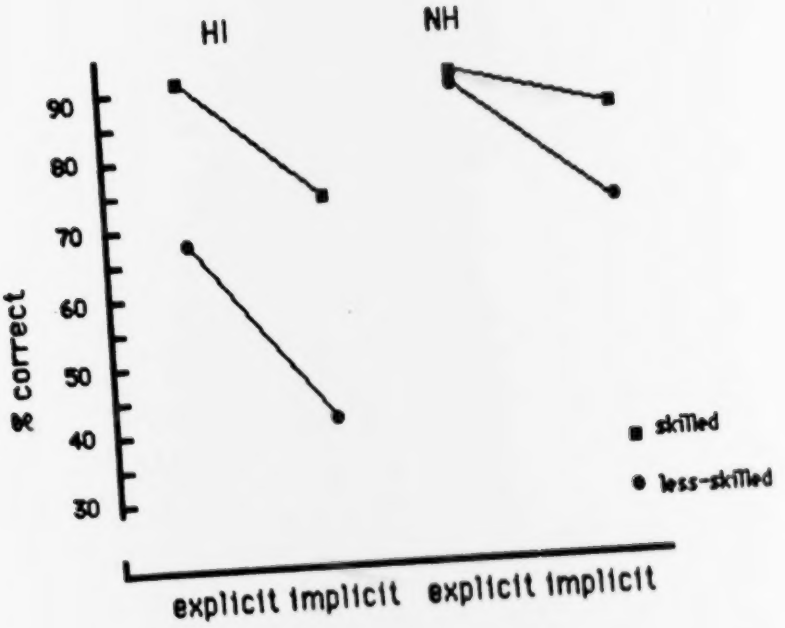

Figure 3. A comparison of conditional inference means by hearing status, reading level and explicitness.